

**WHAT IS CLAIMED IS:**

1. An optical assembly comprising:
  - a first substrate comprising a first surface comprising at least a first structure and at least a first alignment feature;
  - a second substrate comprising a first surface comprising at least a second structure complementary to each of the at least first structures and at least a second alignment feature complementary to each of the at least first alignment features; and
  - a device mounted to at least one of the first surface of the first substrate and the first surface of the second substrates, the device selected from one of a photonic device, an electrical device, and a mechanical device.
2. An optical assembly according to claim 1, wherein the first surface of the first substrate is in physical contact with the first surface of the second substrate such that each of the first alignment features and each of the corresponding second alignment features are in contact thereby permitting each of the at least first structures to be physically aligned with each of the corresponding complementary at least second structures.
3. An optical assembly according to claim 2, wherein the first substrate comprises a chip and the second substrate comprises a chip sub-mount, wherein the chip secures together with the chip sub-mount.

4. An optical assembly according to claim 2, wherein the first substrate comprises a photonic chip and the second substrate comprises a photonic chip sub-mount, wherein the photonic chip secures together with the photonic chip sub-mount.
5. An optical assembly according to claim 2, wherein the first substrate comprises an electronic chip and the second substrate comprises an electronic chip sub-mount, wherein the electronic chip secures together with the electronic chip sub-mount.
6. An optical assembly according to claim 2, wherein the first substrate comprises a mechanical chip and the second substrate comprises a photonic chip sub-mount, wherein the photonic chip secures together with the photonic chip sub-mount.
7. An optical assembly according to claim 3, wherein the chip and the chip sub-mount comprise at least one photonic device chosen from a fiber, a waveguide, a waveguide chip, a laser, a grating, a transmitter, and a detector and wherein the chip sub-mount further comprises at least one electrical device chosen from circuits and circuit elements.
8. An optical assembly according to 3, wherein the chip sub-mount further comprises at least one electrical device chosen from circuits and circuit elements.

9. An optical assembly according to claim 3, wherein at least one of the at least first structures comprises a trench, and wherein a first photonic device is disposed in the trench, and wherein the second substrate comprises the device, such that when the chip and the chip sub-mount are secured together, the photonic device disposed in the trench is aligned with device of the second substrate.

10. An optical assembly according to claim 3, wherein at least one of the at least second structures comprises a trench, and wherein the device is disposed in the trench, and wherein the first substrate comprises a photonic device, such that when the chip and the chip sub-mount are secured together, the device disposed in the trench is aligned with the photonic device of the first substrate.

11. An optical assembly according to claim 9, wherein the trench has a profile selected from a U-shape, a V-shape, a rectangular shape, and a trapezoidal shape.

12. An optical assembly according to claim 10, wherein the trench has a profile selected from a U-shape, a V-shape, a rectangular shape, and a trapezoidal shape.

13. An optical assembly according to claim 3, wherein at least one of the at least first structures comprises a first trench, and wherein a first photonic device is disposed in the first trench, and wherein the second substrate comprises a second trench, and wherein the device is disposed in the second trench, such that when the

chip and the chip sub-mount are secured together, the photonic device disposed in the first trench is aligned with device disposed in the second trench.

14. An optical assembly according to claim 3, wherein the second structure of the second substrate has a recessed geometry that is complementary to a surface geometry of the first structure of the first substrate, wherein the first structure fits into the second structure of the second substrate, and further wherein the first substrate includes at least a photonic device and the second substrate includes the device, and further wherein when the first structure fits into the second structure, the photonic device is aligned with the device of the second substrate.

15. An optical assembly according to claim 3 further comprising:  
a plurality of photonic chips secured to the photonic chip sub-mount.

16. An optical assembly according to claim 1, wherein the first substrate comprises a plurality of chips and the second substrate comprises a plurality of chip sub-mounts.

17. An optical assembly comprising:  
a first substrate comprising a first surface comprising a first device; and  
a second substrate comprising a first surface comprising a first recess,  
wherein a surface geometry of the first recess of the second substrate is complementary to the first surface of the first substrate, and a second device,

wherein contacting the first substrate to the second substrate permits the first surface of the first substrate to fit into the first recess of the second substrate and permits the first device to be aligned with the second device, and further wherein the first and second devices are chosen from photonic devices, electrical devices, and mechanical devices.

18. An optical assembly according to claim 17, wherein the first alignment feature is chosen from one of recesses and projections.

19. An optical assembly according to claim 17, wherein the first device is mounted in a trench in the first surface of the first substrate.

20. An optical assembly according to claim 17, wherein the photonic devices are chosen from a fiber, a waveguide, a waveguide chip, a laser, a grating, a transmitter, a detector and wherein the electrical devices are chosen from circuits and circuit elements.

21. An optical assembly according to claim 17 wherein the first surface comprises a first alignment feature and wherein the second surface comprises a second alignment feature complementary to the first alignment feature.

22. An optical assembly according to claim 17 wherein the recess includes a spacer.

23. An optical assembly according to claim 17, wherein the second substrate comprises a plurality of recesses, wherein each of the plurality of recesses comprises an alignment feature and a device, and wherein the surface geometry of each of the plurality of recesses is complementary to a first surface of a plurality of further substrates, wherein each of the plurality of further substrates comprises an alignment feature and a device chosen from photonic devices, electrical devices, and mechanical devices, such that contacting the alignment feature of each of the plurality of further substrates to the alignment features of each of the plurality of recesses permits each of the further substrates to fit into each of the plurality of recesses thereby permitting the devices of the plurality of recesses to be aligned with each of the plurality of devices of the plurality of further substrates.

24. An optical assembly comprising:

- a first chip comprising a first surface comprising a first locator and a first device;

- a first chip sub-mount comprising a second surface comprising a second locator and a second device, wherein the first surface of the first chip fits into a recess in the second surface of the sub-mount when the first locator contacts the second locator.

25. An optical assembly according to claim 24, wherein the first and second devices are chosen from photonic devices, electronic devices, and mechanical devices.

26. An optical assembly according to claim 24, wherein the first chip sub-mount further comprises a plurality of recesses comprising a further locator, each recess arranged to accept at least one of a plurality of further chips, wherein each chip comprises a locator complementary to at least one of the further locators.

27. An optical assembly according to claim 26, further comprising:  
a first substrate comprising the first chip and each of the plurality of further chips;  
a second substrate comprising the first sub-mount.

28. A method of making an integrated optical assembly comprising:  
forming a first structure and a first alignment feature on a first substrate;  
forming a second structure and a second alignment feature on a second substrate, wherein the second structure and the second alignment feature are complementary in shape to the first structure and the first alignment feature, respectively, on the first substrate;  
positioning a first device on the first substrate;  
positioning a second device on the second substrate; and

contacting the first alignment feature of the first substrate to the second alignment feature of the second substrate thereby permitting the first device on the first substrate to be aligned with the second device on the second substrate.

29. An optical assembly comprising:

a first and a second mechanically matched substrates, each substrate comprising structures, wherein the structures on one substrate comprise shapes complementary to the structures on the other substrate, wherein at least one substrate comprises one or more clipgates for an optical component.

30. An optical assembly according to claim 29, wherein the structures comprise circuits or circuit elements.

31. An optical assembly according to claim 29, wherein said optical component is chosen from a fiber, a waveguide, a laser, a grating, or a detector.

32. A method of making an integrated optical assembly, said method comprising:

(a) fabricating structures on a first substrate;

(b) fabricating structures on a second substrate in shapes complementary to the structures on the first substrate, wherein at least one of said first and second substrates comprise a clipgate for an optical component;

(c) mechanically positioning an optical component in said clipgate;

(d) bringing said first and second substrates into face-to-face configuration such that the complementary shaped structures are aligned;

(e) physically contacting said first and second substrates; and

(f) pressing the said first and second substrates together.

33. A method of making an integrated optical assembly of claim 32, further comprising:

providing a mechanical holding device, or adhesive bonding.

34. A method of making an integrated optical assembly of claim 32, wherein the assembly is cut to fabricate a plurality of isolated individual device components.

35. The method of making an integrated optical assembly of claim 32, wherein said fabricating of (a) and (b) are chosen from at least one of multilayer lithography, 3-D lithography, molding, embossing, stamping, replicating, and direct machining.

36. The method of making an integrated optical assembly of claim 32, wherein the structures on said first and second substrates comprise circuits or circuit elements.

37. An optical assembly according to claim 1, wherein the first substrate is made from a material chosen from at least one of glass, polymers, semiconductors,

metals, and composites, and further wherein the second substrate is made from a material chosen from at least one of glass, polymers, semiconductors, metals, and composites.

38. An optical assembly according to claim 17, wherein the first substrate is made from a material selected from at least one of glass, polymers, semiconductors, metals, and composites, and further wherein the second substrate is made from a material selected from at least one of glass, polymers, semiconductors, metals, and composites.

39. An optical assembly according to claim 24, wherein the chip is made from a material selected from at least one of glass, polymers, semiconductors, metals, and composites, and further wherein the chip sub-mount is made from a material selected from at least one of glass, polymers, semiconductors, metals, and composites.